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Chronic Bronchitis and Chronic Obstructive Pulmonary Disease (COPD) Among Textile Workers in Karachi, Pakistan

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ABSTRACT

Objective: To determine the frequency and predictors of chronic bronchitis and COPD among textile workers in Karachi, Pakistan.

Study Design: Cross-sectional survey.

Place and Duration of Study: Karachi, Pakistan, from October to December 2009.

Methodology: Male textile workers from 15 mills of Karachi were inducted. Data was collected using American Thoracic Society respiratory questionnaire (ATS-DLD-78-a) and spirometry.

Results: Out of 372 participants, 29 (7.8%) workers had chronic bronchitis (4, 9.1% aged ≥ 40 years) and 25 (6.7%) had COPD (12, 27.2% aged ≥ 40 years). Workers with chronic bronchitis had significantly decreased lung function compared to the healthy workers. Those reporting severe self-perceived dust exposure at work, ≥ 10 pack years of smoking, uneducated, longer duration of work (≥ 11 years), and ever smokers were more likely to have chronic bronchitis or COPD. In the multivariate analyses, severe self-perceived dust exposure at work (AOR = 7.4; 95% CI: 1.9, 28.0), family history of respiratory illness/symptoms (AOR = 4.8; 95% CI: 1.1, 20.9) and lack of education (AOR = 4.2; 95% CI: 1.1, 16.9) were significant predictors of chronic bronchitis. Duration of work ≥ 11 years (AOR = 5.5; 95% CI: 1.5, 19.7) and pack years of smoking ≥ 10 years (AOR = 3.5; 95% CI: 1.1, 11.7) were strong predictors for COPD.

Conclusion: There is a high frequency of chronic bronchitis and COPD among textile workers. Multiple important predictors for prevention are identified.

Key Words: Chronic bronchitis. Chronic obstructive pulmonary disease (COPD). Lung function. Pakistan. Textile workers. Prevention. Smoking. Exposure duration.

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is characterized by persistent airflow limitation assessed through lung function tests, while chronic bronchitis refers to presence of productive cough for at least 3 consecutive months a year for at least 2 years.¹ Since these are two independent disease entities and the presence of one does not preclude the presence of other, therefore, it is important to identify the burden of both separately.¹ COPD affects about 65 million people worldwide and contributes to 5% of overall deaths, globally.² The burden of COPD continues to rise globally and is projected to become the third leading cause of death by 2030, after ischemic heart disease and cerebrovascular diseases.² Albeit the limitation in assessment due to use of variable methods and definitions of COPD, a systematic review based on data from 28 developed and developing countries reported a

pooled prevalence of 7.6% globally.³ Reported risk factors for COPD include hereditary predisposition, tobacco smoking, occupational exposure to dusts and fumes, indoor (use of bio-mass fuel, especially in developing countries) and outdoor air pollutants, ageing, infections, asthma and low socio-economic status.^{4,5}

Tobacco smoking is the leading cause of COPD worldwide, while among other modifiable risk factors, occupational exposures to various pollutants are a major risk.^{5,6} Population attributable risk percent (PAR%) of COPD associated with occupational exposures is at least 15% globally.⁷ Zock *et al.* reported that occupations such as agriculture, textile, paper, wood, chemical, and food processing workers are at increased risk of chronic bronchitis.⁸

Textile industry is known to be associated with several harmful exposures, especially cotton dust, which may lead to respiratory symptoms and illnesses including chronic bronchitis, byssinosis, as well as lung function impairment.⁹ Textile industry is one of the major revenue generating sectors of Pakistan employing a large workforce throughout the country.¹⁰ Pakistan reports a byssinosis prevalence of 10.5% among textile workers in Karachi.¹¹ However, there is limited data regarding the burden of chronic bronchitis and COPD among textile workers in Pakistan as well as globally. Therefore, the objective of this study was to determine the frequency and predictors of chronic bronchitis and COPD among textile workers in Karachi, Pakistan.

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METHODOLOGY

This was a cross-sectional analytical study conducted in 2009 among 372 male textile workers of Karachi, Pakistan.¹¹ The city has 794 registered textile units with approximately 40,500 workers primarily involved in processing of cotton and synthetic textiles.¹²

This study included 15 textile mills selected purposefully to represent the 5 main industrial areas in Karachi: Korangi/Landhi Industrial Area, North Karachi Industrial Area, Federal 'B' Area Industrial Area, Sindh Industrial Trading Estate (SITE), and SITE Super Highway. In addition, sites from the suburbs of Karachi were also included (Ittehad Town, Baldia Town, and SITE Nooriabad). After the initial approval from the administration at each mill, study team selected participants who were aged ≥ 18 years and had at least a year's experience of working in the textile industry. Participants were recruited from the spinning and weaving sections of the mills since these are the areas which involve high dust exposure. This study included only male participants. A minimum sample of 264 workers was required to achieve a 95% confidence level with 5% bound on error for an estimated frequency of chronic bronchitis of 14% and COPD 22%.^{4,9}

The (ATS-DLD-78-a) questionnaire was used for assessing respiratory symptoms including cough, phlegm, wheeze, and shortness of breath, as well as other chest and past illnesses and family history.¹³ Questions pertaining to chest tightness were added from the WHO respiratory questionnaire.¹⁴ Sections related to socio-demographic variables, smoking and occupational exposures were also included. The structured questionnaire was translated into Urdu and pretested before use in study. Interviews were conducted by trained data collectors in a convenient room or place identified within the premises of the textile mills.

Lung function measurements were performed with a portable spirometer (Vitalograph New Alpha 6000; Vitalograph Ltd., Buckingham, England) according to the American Thoracic Society guidelines.¹⁵ Percentage predicted Forced Expiratory Volume in the first second (FEV_1), Forced Vital Capacity (FVC) and their ratio (FEV_1/FVC) were recorded. Participants were asked to refrain from smoking for at least one hour before spirometry. All spirometry measurements were made in a standing position without nose clips. The procedure was explained to participants and they were asked to practice until they felt comfortable. Results of 3 acceptable readings were recorded and the best of the 3 readings was used for further analysis. Those found to have an obstructive pattern on spirometry were administered a bronchodilator and reassessed through spirometry after 15 minutes.

Chronic cough or phlegm was defined as cough or phlegm for at least 3 consecutive months a year, for at

least 2 years. Chronic wheeze was defined as whistling sounds from chest (with or without cold), for at least 2 years. Chronic bronchitis was defined as presence of both chronic cough and chronic phlegm. COPD was diagnosed according to GOLD (Global initiative for chronic Obstructive Lung Disease) criteria as those having post-bronchodilator FEV_1/FVC ratio < 0.7 . Spirometric interpretation was normal ($FEV_1/FVC > 0.7$, FEV_1 and FVC $> 80\%$ predicted); obstructive ($FEV_1/FVC < 0.7$, $FEV_1 < 80\%$ predicted); restrictive ($FEV_1/FVC > 0.7$, FEV_1 and FVC $< 80\%$ predicted); and mixed (a combination of obstructive and restrictive patterns).

The study was approved by Ethics Review Committee of The Aga Khan University (848-CHS/ERC-07), Karachi. Informed consent was taken from all participants and confidentiality of data was strictly maintained.

Data was entered on Epidata 3.1 and analyzed using SPSS version 19.0 (SPSS Inc., Chicago, IL, USA). Frequencies were calculated for categorical variables while mean and standard deviation (or median and inter-quartile range) for continuous variables. Frequency was estimated for presence of chronic bronchitis, COPD as well as spirometric interpretation. Individuals with COPD were further categorized on the basis of severity according to the GOLD criteria. Lung function was compared amongst those who were categorized as having chronic bronchitis and those as normal using student's t-test. Distribution of various co-variables according to the status of chronic bronchitis and COPD was assessed through chi-square test.

Univariate odds ratios (OR) and their 95% confidence intervals (CI) were calculated to assess associations between chronic bronchitis and co-variables (including marital status, ethnicity, mill cluster, household income per person, section of mill, smoking status, pack years of smoking, age at starting smoking, duration of work, history of work in dusty job, self-perceived dust exposure, educational status, and family history of respiratory illness or symptoms). All variables with p-value of ≤ 0.25 and those which had biologically plausible relationship with chronic bronchitis or COPD were included in multivariate models. Adjusted odds ratios (AOR) with their 95% CIs were calculated through multivariate logistic regression analysis.

RESULTS

Out of 372 textile workers, 29 (7.8%) had chronic bronchitis and 25 (6.7%) had COPD. Out of 29 workers who had COPD, 4 workers also reported chronic bronchitis (16% overlap). The frequency of chronic bronchitis and COPD increased to 9.1% ($n=4/44$) and 27.2% ($n=12/44$), respectively for participants of 40 years or older. Most of the workers (52%; $n=13$) with COPD were categorized as GOLD 2, i.e. having moderate severity while there were no workers in the GOLD 4 category, i.e. very severe COPD.

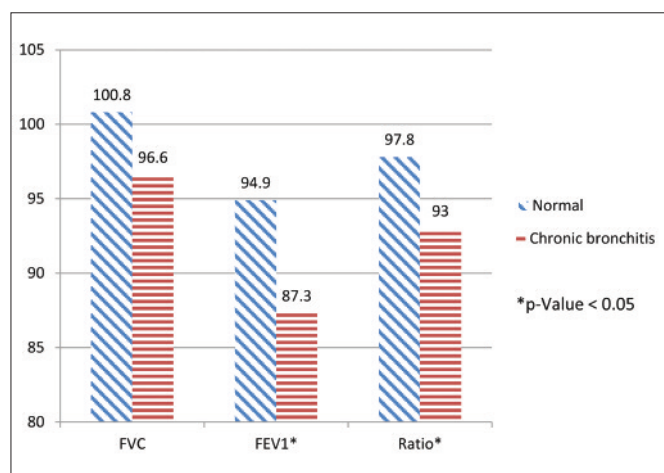


Figure 1: Graphical representation of percentage predicted lung function indices according to status of chronic bronchitis among textile workers (n = 372), Karachi, Pakistan.

Workers categorized as having chronic bronchitis had significantly decreased lung function (including decrements in FVC, FEV1 and FEV1/FVC ratio) compared to the healthy workers (Figure 1). Workers with chronic bronchitis had mean percentage predicted FVC of 96.6% compared to 100.8% ($p = 0.216$) in healthy workers. Similarly, mean percentage predicted FEV1 among these workers was 87.3% compared to 94.9% ($p = 0.028$) in healthy workers and FEV1/FVC ratio was 93% compared to 97.8% ($p = 0.017$) in healthy workers.

Frequency distributions of socio-demographic, anthropometric and other risk factors, according to the status of chronic bronchitis and COPD of the textile workers, are given in Table I. Workers reporting severe self-perceived dust exposure at work ($p = 0.001$) were more likely to have chronic bronchitis. Whereas, those with up to 10 pack years of smoking ($p = 0.002$), those who were educated ($p = 0.035$), had progressively increasing duration of work ($p < 0.001$), and those reporting to have ever been smokers ($p = 0.001$), were more likely to have COPD. Mean age of workers with COPD was 36.5 ± 10.5 years compared to 26.5 ± 7.9 years ($p < 0.001$) among the healthy workers.

Univariate analysis for factors associated with chronic bronchitis found that workers reporting severe self-perceived dust exposure at work compared to mild to moderate exposure (OR = 6.1; 95% CI: 1.8 to 20.0) were more likely to have chronic bronchitis (Table III). After adjusting for potential confounders in the multivariate analysis, severe self-perceived dust exposure at work (Adjusted Odds Ratio (AOR) = 8.1; 95% CI: 2.1 to 32.0) and family history of respiratory illness or symptoms (AOR = 4.7; 95% CI: 1.1 to 20.5) were significant predictors of chronic bronchitis (Table II).

Univariate analysis for factors associated with COPD found that workers who were ever married compared to

the never married (OR = 3.2; 95% CI: 1.3 to 8.3), had pack years of smoking < 10 years compared to non-smokers (OR = 1.9 95% CI: 2.1 to 20.2), duration of work ≥ 11 years compared to 1 - 5 years (OR = 6.2; 95% CI: 1.8 to 21.8) and were ever smokers compared to never smokers (OR = 2.6; 95% CI: 1.1 to 6.0) were more likely to have COPD. After adjusting for potential confounders in the multivariate analysis, duration of work ≥ 11 years (AOR = 5.5; 95% CI: 1.5, 19.7) and pack years of smoking ≥ 10 years (AOR = 3.5; 95% CI: 1.1, 11.7) were strong predictors of COPD (Table III).

DISCUSSION

This study found the overall frequency of chronic bronchitis to be 7.8% and of COPD to be 6.7%. Those with chronic bronchitis had significant decrements in lung function compared to the healthy workers. After adjusting for possible confounders, self-perceived dust exposure, family history of respiratory illness or symptoms and lack of education were significant predictors of chronic bronchitis; furthermore, duration of work ≥ 11 years and pack years of smoking ≥ 10 years were strong predictors of COPD among this group of industrial workers from Pakistan.

The frequency of 7.8% for chronic bronchitis, determined by this study, is high compared to the recent estimates of 3.4% in neighboring India.¹⁶ The overall frequency of 6.7% for COPD among this study participants rose to 27.2% among those aged 40 years or above, signifying a huge burden of respiratory illness as well as the association of COPD with ageing.⁴ Recent multi-country data in this age group from the BOLD study reports the prevalence of stage-I COPD varying between 1.4% in the Philippines, to 15.5% in Austria,¹⁷ which is also lower than the findings of this study.

Pakistan reports a prevalence of 9% for chronic bronchitis among those from the urban areas, aged more than 65 years,¹⁸ and it is apparent that the prevalence below this age group would be much lower.¹⁹ Recent estimates available from the BREATHE study suggest a chronic bronchitis prevalence of 2.9% for those aged ≥ 40 years in Pakistan which highlights a high prevalence among textile workers found in our study.²⁰ An overall prevalence of 23% was reported for chronic bronchitis among Ethiopian textile workers,²⁰ which is higher compared to this study. The Ethiopian study was conducted at a single textile mill and there were differences in the definition of chronic bronchitis. Chronic bronchitis prevalence among textile workers of 9.3% from China have been reported, which is similar to findings from this study.¹⁰ Niven *et al.* reported a chronic bronchitis prevalence of around 7% among Lancashire textile workers in spinning section exposed to cotton dust, while those working in the man-made fiber mills were found to have a lower prevalence of around 4%.²¹ Raza *et al.* found the prevalence of chronic bronchitis to

Table 1: Frequency distribution of socio-demographic, anthropometric and other risk factors, according to status of chronic bronchitis and COPD among textile workers (n=372), Karachi, Pakistan.

Variable	Chronic bronchitis			COPD		
	Absent (n= 343)	Present (n=29)	p-value	Absent (n=347)	Present (n=25)	p-value
	n (%)	n (%)		n (%)	n (%)	
Marital status						
Never married	169 (49)	12 (41)	0.41	175 (50)	6 (24)	0.01
Ever married	174 (51)	17 (59)		172 (50)	19 (76)	
Section of mill						
Weaving	180 (52.5)	18 (62)	0.32	188 (52)	10 (40)	0.17
Spinning	163 (47.5)	11 (38)		159 (46)	15 (60)	
Pack years of smoking						
Non smoker	199 (58)	16 (55)	0.79	206 (59)	9 (36)	0.002
Up to 10 years	120 (35)	10 (35)		120 (35)	10 (40)	
10 or more years	24 (7)	3 (10)		21 (6)	6 (24)	
Education						
Educated	255 (74)	20(69)	0.52	261 (75)	14 (56)	0.035
Uneducated	88 (26)	9 (31)		86 (25)	11 (44)	
Duration of work						
1-5 years	108 (31)	10 (34)	0.64	115 (33)	3 (12)	<0.001
6-10 years	124 (36)	8 (28)		127 (37)	5 (20)	
11 years or more	111 (32)	11 (38)		105 (30)	17 (68)	
Smoking status						
Never smoker	199 (58)	16 (55)	0.76	206 (59)	9 (36)	0.022
Ever smoker	144 (42)	13 (45)		141 (41)	16 (64)	
Mill cluster ^a						
Cluster 1	118 (34)	11 (38)	0.90	120 (35)	9 (36)	0.757
Cluster 2	119 (35)	9 (31)		121 (35)	7 (28)	
Cluster 3	106 (31)	9 (31)		106 (30)	9 (36)	
Ethnicity ^b						
Punjabi	95 (28)	8 (28)	0.64	95 (27)	8 (32)	0.631
Sindhi	109 (32)	7 (24)		107 (31)	9 (36)	
Others	139 (40)	14 (48)		145 (42)	8 (32)	
History of work in dusty job						
No	187 (54)	17 (59)	0.67	193 (56)	11 (44)	0.26
Yes	156 (45)	12 (41)		154 (44)	14 (56)	
Self-perceived dust exposure ^c						
Mild to moderate	127 (81)	5 (42)	0.001	123 (80)	9 (64)	0.153
Severe	29 (19)	7 (58)		31 (20)	5 (36)	
Family history of respiratory illness or symptoms						
No	296 (86)	23 (79)	0.301	297 (86)	22 (88)	0.51
Yes	47 (14)	6 (21)		50 (14)	3 (12)	
Household income per person ^d						
Highest	86 (25)	7 (24)	0.156	90 (26)	3 (12)	0.154
Low	90 (26)	4 (14)		90 (26)	4 (16)	
Lower	86 (25)	6 (21)		83 (24)	9 (36)	
Least	81 (24)	12 (41)		84 (24)	9 (36)	
Age (years) mean (SD)	27.1 (8.5)	27.5 (8.3)	0.82	26.5 (7.9)	36.5 (10.5)	<0.001
Height (cm) mean (SD)	167.1 (6.3)	168.1 (5.5)	0.43	167.2 (6.2)	167.2 (6.0)	0.98
Weight (kg) mean (SD)	58.6 (11.6)	59.0 (8.9)	0.83	58.7 (11.4)	57.3 (12.2)	0.56

Values presented as n (%), unless otherwise noted

^a where cluster 1 comprises of: SITE Super Highway and Landhi / Korangi Industrial Areas; cluster 2: Baldia Town, Ittehad Town and SITE; cluster 3: SITE Nooriabad, North Karachi and F.B. Area Industrial areas^b includes other ethno-linguistic groups: Baluchi, Seraiki, Hindko, Kohistani and Kashmiri^c includes those who reported a past history of work in any dusty job^d Calculated by dividing the monthly household income in Rupees (1 US \$ = 107 PKR) by number of household members. The continuous variable was later categorized into quartiles based on monthly household income per household member, where; High > Rs: 2553, Low = Rs: 1714-2553, Lower = Rs: 1157-1714, and Least < Rs: 1157.

Table II: Multivariate logistic regression analysis^a for predictors of chronic bronchitis among textile workers (n=372), Karachi, Pakistan.

Variable	AOR	95% CI
Self-perceived dust exposure ^b		
Mild to moderate	1	-
Severe	7.4	1.9, 28.0
Family history of respiratory illness or symptoms		
No	1	-
Yes	4.8	1.1, 20.9
Education		
Educated	1	-
Uneducated	4.2	1.1, 16.9
Smoking status		
Never smoker	1	-
Ever smoker	1.1	0.3, 4.4
Household income per person ^d		
Highest	1	-
Low	0.7	0.1, 4.5
Lower	0.3	0.03, 2.3
Least	1.1	0.2, 6.4

^a All the variables in the model are mutually adjusted for each other.^b Includes those who reported a past history of work in any dusty job.^d Calculated by dividing the monthly household income in Rupees (1 US \$ = 107 PKR) by number of household members. The continuous variable was later categorized into quartiles based on monthly household income per household member, where; High > Rs: 2553, Low = Rs: 1714-2553, Lower = Rs: 1157-1714, and Least < Rs: 1157.**Table III:** Multivariate logistic regression analysis^a for predictors of COPD among textile workers (n=372), Karachi, Pakistan.

Variable	AOR	95% CI
Duration of work		
1-5 years	1	-
6-10 years	1.6	0.4, 6.9
11 years or more	5.5	1.5, 19.7
Pack years of smoking		
Non-smoker	1	-
Less than 10 years	1.8	0.7, 4.7
10 or more years	3.5	1.1, 11.7
Section of mill		
Weaving	1	-
Spinning	1.9	0.8, 4.8
Education		
Educated	1	-
Uneducated	1.9	0.8, 4.6

^a All the variables in the model are mutually adjusted for each other

be 6% among Lancashire textile weavers.²² These findings are similar to this study where we found an overall frequency of 7.8%. This study found a lower frequency of 6.3% in the spinning section compared to 9% in the weaving section which was unexpected. There could be several possible explanations for this; there was a slightly higher proportion of smokers in the weaving section, workers with greater duration of work as well as differences in the ethnic make-up of population in the 2 sections which could have affected our results.¹¹

This study identified pack years of smoking ≥ 10 years or more and duration of work ≥ 11 years (AOR = 5.5) to be strong predictors of COPD (AOR = 3.5), while

uneducated were more likely to report chronic bronchitis (AOR = 4.2) findings, which have been consistently reported in previous literature.^{4,11} In the final multivariate analyses after adjusting for smoking, education status and age, it was found that textile workers with a past family history of any respiratory illness or symptom were more likely to report chronic bronchitis (AOR = 4.8), which relates to previous findings regarding role hereditary factors in the initiation and severity of COPD.⁴ It was also found that self-perceived dust exposure was a strong predictor of chronic bronchitis (AOR = 7.4) which has been reported by several studies, demonstrating the significance of exposure to cotton dust and possible role of bacterial endotoxins.²²

Important strengths of this study include objective assessment of lung function done through spirometry measurements that were both pre- and post-bronchodilator, and were according to the ATS specifications. Furthermore, questionnaires were administered by trained personnel in the participants' native language and there were large number of mills which were surveyed; thus improving the generalizability of our findings. Moreover, since there is paucity of literature on respiratory health of textile workers in developing countries such as Pakistan, this work will add significantly to the existing body of literature.

There are few limitations which should be considered for this study. Only male textile workers were included due to negligible number of females in the spinning and weaving sections of textile industry in Pakistan. Therefore, the authors were not able to find gender related differences as determined by other studies.⁴ Healthy worker effect may have led to an under-estimation of the findings of this study, although the authors tried to adjust for this, taking into account the duration of work for each worker. The question related to self-reported dust exposure was the only form of exposure assessment that could be considered in this study due to limited resources, and this exposure assessment could have been an overestimation due to recall bias as workers suffering from respiratory disease may have been more likely to recall the dust exposure.

Possible overlap between the diagnosis of asthma, byssinosis and COPD may also have affected the findings of this study.⁴ Information was also collected regarding respiratory symptoms including chronic bronchitis, which is required to improve the assessment and better characterize COPD.¹ These symptoms are a better predictor of survival and have been found to be associated with impaired quality of life even in patients without COPD.²³ Moreover, presence of respiratory symptoms may precede the onset of clinically diagnosed COPD and thus it is important to identify individuals at the early stage to better target the preventive measures. The ATS-DLD-78-a questionnaire was used which is a standard tool used in large number of studies on various occupational groups and has also been found to have

good validity in several languages.¹³ Since this was a cross-sectional study, the authors were not able to take into account any long-term changes affecting the respiratory health of these textile workers.

CONCLUSION

This study found high frequency of chronic bronchitis and COPD among textile workers from Pakistan. In addition to smoking, family history or respiratory illness, age, and self-reported dust exposure were identified to be an important predictor for chronic bronchitis. Appropriate preventive measures need to be undertaken urgently in order to protect large number of textile workers from the exposure to cotton dust leading to chronic bronchitis and COPD.

Disclosure: The primary survey on textile workers was funded through the University of Alabama at Birmingham (UAB), International Training and Research in Environmental and Occupational Health (ITREOH) programme, grant number 5D43TW005750-08.

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- Disclosure:** The primary survey on textile workers was funded through the University of Alabama at Birmingham (UAB), International Training and Research in Environmental and Occupational Health (ITREOH) programme, grant number 5D43TW005750-08.
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